

How to Advise Owners about the "Cancer Diet"

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Owners of cancer patients easily find information on the web about feeding a "cancer diet". In a 2006 study from the CSU Animal Cancer Center, 65% of pets were being administered alternative therapies. Of the various modalities available, nutritional supplements were the only being used by 40% of the owners, with prayer a close second. Approximately 35% were using diet as part of cancer therapy, and about 30% were using vitamins (Lana 2006).

Cancer and Nutrition for Humans

Prevention

Food plays a very important preventive role in human cancer - at least 35% of all human cancers are preventable with proper nutrition, although the number is dependent on individual variables like an individual's diet and the specific cancer type (World Cancer Research Fund 1997). It is well recognized that fiber, fruits and vegetables (and especially cruciferous vegetables) have a protective effect, and that avoiding other foods, such as fat, excess refined foods and grilled meats, can decrease cancer risk. Phytonutrients such as flavonoids, isothiocyanates, and protease inhibitors contained in plants are believed to play a major preventive role, and people can get increased levels by eating fruits, vegetables, spices and green tea. Omega-3 fatty acids from plants and fish may also offer some protection.

Treatment

Nutrition in human cancer patients is targeted towards maintaining nutrient intake, often in the face of factors that negatively affect the appetite, such as nausea, vomiting, fatigue, loss of taste or smell sensations, pain, and stomatitis. Studies are ongoing to definitively establish the benefit of assisted nutrition on disease outcome, but intuitively, we can recognize that maintaining calorie, protein, and other nutrient intake should improve response to treatment. Although in the past, intentional weight loss was not recommended for obese cancer patients, newer studies show that this may improve survival.

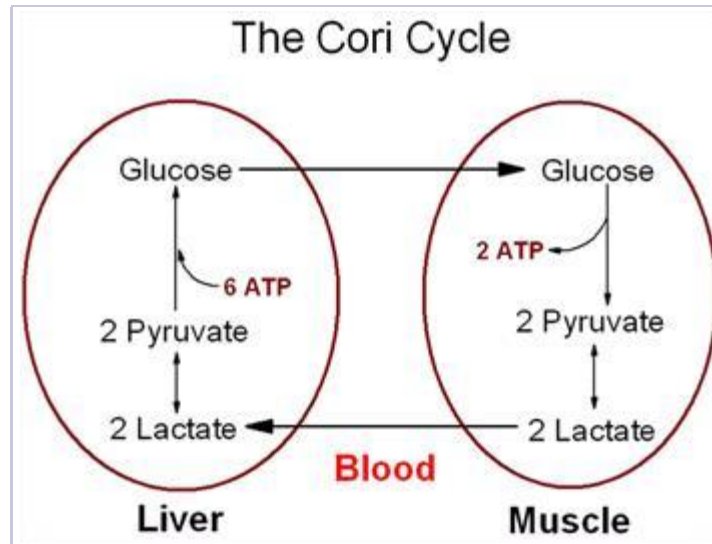
Cancer survivors are highly motivated to make lifestyle changes, and studies in these patients have confirmed that inclusion of more vegetables in the diet, maintenance of a healthy body weight, and an exercise program enhance survival and/or reduce recurrence rates (Rock 2002; Chan 2005). If we consider that the goal of some cancer therapy is to make the disease more chronic (where cure is not an option), these interventions amount to a part of cancer therapy. In one case control study in women with invasive ovarian cancer, for instance, those with increased intake of vegetables experienced better survival times (Nagle 2003).

Differences in Metabolism in Cancer Patients

Warburg (1930) first described the unique ability of tumor cells to take up large amounts of glucose, and they can metabolize it only via anaerobic glycolysis. The end result of tumor glycolysis is release of lactate into circulation. The patient converts lactate back to glucose via the Cori cycle. Increased lactate negatively affects Cori cycle functioning, resulting in a net loss in energy. Tumors also preferentially metabolize certain amino acids at the expense of the host.

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The metabolic state of cancer patients resembles that of a Type II diabetic - these patients exhibit glucose intolerance, glucose recycling, increased hepatic glucose production, and insulin resistance. A recent study showed that administration of insulin to human patients with a variety of cancers significantly improved food intake and survival (Lundholm 2007).

Lactate, resting insulin and glucose levels are elevated in dogs with cancer (Ogilvie 1994a), and they do not improve after treatment (Ogilvie 1992). Studies in dogs have shown that those with cancer have different lipid profiles than normal dogs. Dogs with cancer had higher levels of cholesterol, total triglyceride and very low density triglycerides, and treatment normalized only cholesterol levels (Ogilvie 1994b).

In theory, a diet low in carbohydrates would help to minimize lactate production and prevent complications of glucose intolerance. Special diets targeted towards ameliorating these metabolic changes have been tested in dogs, though apparently not in humans. A high carbohydrate, low fat diet resulted in elevated lactate and insulin levels in dogs with cancer. A high fat, low carbohydrate diet increases the probability that dogs with lymphoma would go into remission and have longer survival times (Ogilvie 2003; Tisdale 1987).

Dietary management using these principles is still controversial, as oncologists note that the majority of dogs and cats die or are euthanized because of their tumors, but are not cachectic, suggesting that this state of insulin resistance and hyperlactatemia has little clinical significance. I do recommend low carbohydrate diets, however, based on the fact that dogs and cats have no dietary requirement for carbohydrates and on my positive observations of cancer patients on these diets over the years.

A commercial diet formulated to be low in digestible carbohydrates, high in fat (particularly n-3 PUFA) and moderate in protein is Hill's N/D for dogs. Clients often find "grainless" commercial "holistic" diets, but the clinician should be aware that if the food in question is a dry food, it must be processed using some kind of starch, and most of these foods contain potato or tapioca. These are starch sources and should perhaps be avoided if possible. Even the canned foods are unlike the prescription diet, as their fatty acid profiles do not match the high n-3:n-6 proportion in the N/D formulation. No studies were found regarding therapeutic diets for cats with cancer, but most cats do very well eating a Paleolithic (low carbohydrate) diet.

Homemade diets are sometimes more appropriate, as animals may have changes in appetite due to the course of their disease, or may have other disease conditions to be addressed in addition to cancer. In addition, some clients will prefer fresh food ingredients that provide whole food sources of phytonutrients. I recommend consulting a veterinary nutritionist for a customized diet, but if the client is unable or unwilling, the diet below is complete and balanced (as analyzed). The client must understand that the supplements are not optional and cannot be dropped for convenience, and it is safer as a rule to supply a diet that is higher in variety than one formulated recipe.

Generic Cancer Diet for Dogs

Chicken breast, no skin, broiled, baked or stewed	1 lb
Vegetables*	1½ cup
Calcium carbonate powder	¾ teaspoon
Salmon oil	5 teaspoons
Centrum Adult Multi Vitamin & Mineral	2 tablets
Choline bitartrate, 500mg/tablet	½ tablet

*Use a variety of vegetables of all colors, and be sure to include cruciferous types. Choose mostly from broccoli, cabbage, carrots, bok choy, kale, red/yellow bell peppers, shiitake or maitake mushroom, etc.

This recipe makes a batch of about 800 grams, supplying about 1000 kcal which is enough for an active 45 lb dog. It is lower in fat than Hill's N/D.

Raw Diets

Finally, many clients, in their internet searches for cancer cures, will discover raw diets. Some may choose to use a raw plan despite the dangers of doing so in immune suppressed animals. I recommend putting a note in the record that the client has been counseled on the risks. As published in JAVMA, "*Veterinary recommendation of raw meat feeding may result in serious legal ramifications*" (LeJeune, 2001).

N-3 Fatty Acids

N-3 fatty acids have a number of effects in cells, influencing membrane fluidity, permeability, and lipid packing; the activity of proteins such as protein kinase C and Na⁺ K⁺ ATPase; gene synthesis, and eicosanoid synthesis (Siddiqui 2004). They may also modulate matrix metalloproteinase activity (Roudebush 2005). Eicosanoid generation, controlled in part by COX-2, may be involved with the development and progress of a number of tumors. DHA is an n-3 fatty acid which is a component of fish oil, and may down-regulate expression of COX-2 (Tapiero 2002). EPA reduces protein catabolism and lipolysis, and so helps to prevent cancer cachexia (Roudebush 2005).

Evidence from *in vitro* and laboratory animal studies suggest that EPA and DHA from fish oil have anti-cancer effects, and human epidemiologic studies tend to suggest the same. Clinical trials in dogs with lymphoma, nasal tumors, hemangiosarcoma, and osteosarcoma also support the use of fish oil in companion animals with cancer.

Clinical studies of fish oil use in dogs with cancer are claimed to prove that fish oil is beneficial; however, these studies are complicated by the use of other strategies, such as arginine supplementation and a low carbohydrate diet. However, feeding the diet high in fish oil did result in higher serum levels of EPA and DHA, and survival was improved in these dogs. The dose of fish oil used in these trials is equivalent to 12 -20 regular strength fish oil capsules for a 10kg dog (Roudebush, 2005).

The dose of fish oil suggested above is equivalent to 360-600mg/kg BW of the combination of EPA and DHA. This can be achieved by using fish oil as the fat source in a homemade diet. Most pet owners who are unable to feed N/D find supplementing the diet with a lower dose to be acceptable, though it is unknown if these low doses are effective. For this purpose, I recommend a dose of 80-240 mg/kg BW, which is 1-2 extra strength capsules per 5 kg BW.

Mushrooms

Mushrooms can be included as part of a homemade cancer diet or as treats, if pets like the taste. Medicinal mushrooms are often of inedible types (like ganoderma or reishi), but the better known shiitake and maitake mushrooms are edible and medicinal at the same time. Medicinal mushroom polysaccharides bind numerous cellular receptors and appear to be multi-cytokine inducers (Maeda 1994; Maeda 1996). Early trials have identified lentinan from shiitake mushroom (*Lentinus edodes*), PSK and PSP from turkey tail (*Trametes versicolor*), schizophyllan (sonifilan) from *Schizophyllum commune*, and Grifon-D from Maitake (*Grifola frondosa*). The complexity of this interaction with the immune system is of benefit to the cancer patient, where it is believed that targeting multiple vulnerabilities of the cancer cell is advantageous. While there are many positive *in vitro* and experimental animal

studies supporting the theory that mushrooms have anticancer effects, the few controlled clinical trials in people are less consistent. More work remains to be done, but in the meantime, the safety of using whole mushrooms or mushroom extracts makes them an attractive addition to the diet.

When Should the "Cancer Diet" Not Be Fed to Veterinary Cancer Patients?

Every cancer is different, and test tube studies on human cancer cells suggest that different cancers respond differently to various nutritional profiles in their media. More importantly, every cancer **patient** is different, and the diet offered should incorporate the iterative process recommended by the American College of Veterinary Nutrition. Choosing a diet involves assessment of the candidate diet itself, the patient's condition and nutritional needs, and environmental factors such as the owner's ability to feed the recommended diet, presence of other pets, and owner's attitudes towards diet.

The dietary key to influencing cancer proliferation is that the diet be high in fat - tumor cells are unable to use fat as an energy source, whereas dogs and cats can do this very efficiently. So the "low carb diet" for cancer patients is usually quite high in meat (which contains a lot of fat), low in starches and sugars, and contains added fat. A logical conclusion is that for pets with cancer only - no pancreatitis, no advanced renal disease, no obesity, etc. - a low carb, moderate protein, high fat food makes sense. But for patients with these other disorders, the diet can not only worsen the prognosis but even make death from the other disease more imminent than death from cancer. While pancreatitis and Stage 3-4 renal disease are recognized contraindications for the high fat, moderate protein diet, I'd like to suggest that obesity is a contraindication as well.

Obesity is the most common nutritional disorder seen in dogs and cats. Obesity leads to hyperglycemia and insulin resistance. This hyperglycemia is much more persistent than the elevated glucose load that occurs after any meal of any composition. In addition, surgery, radiation and chemotherapy can cause changes in endocrine functions that could increase the likelihood of development of metabolic syndrome (de Haas 2010). Cancer itself is commonly associated with hyperglycemia (Heber 2006). Whether this persistent hyperglycemia and insulin resistance leads to worse outcomes in veterinary patients is unknown, but glycemic control is routinely recommended in human patients when hyperglycemia is identified (Heber 2006). This is both to control episodes of infection (made more likely through the use of immune suppressive therapies), but also to prevent progression to metabolic syndrome and diabetes which is a risk factor for the development of other cancers.

Obesity is also an 'inflammatory disease', as is cancer. Fat is now considered an organ that releases excess inflammatory cytokines, such as tumor-necrosis-factor- α (TNF- α) and interleukin 6 (IL-6) (de Haas 2010). These cytokines are considered growth factors that can activate genes that control angiogenesis, invasion and metastasis of cancer cells.

The obese cancer patient then gets a double shot of hyperglycemia, and more inflammatory chemicals already being produced by the tumor itself. These patients just have to be 'sicker' - whether or not they show it - than patients of normal weight. Hence, the new evidence that some obese human cancer patients have worse outcomes than people of normal weight. This has been shown most frequently in breast, prostate and colon cancer (Ramos 2010; Sinicrope 2010; Komaru 2010; Siegel 2010; de Azambuja 2010; Lange 2008; Nitori 2009; Weitzen 2006). Additionally, some recent trials suggest that overweight patients undergoing controlled weight loss during cancer treatment experienced improved prognosis (Freedland 2009).

I've lost clients who refuse to believe that the cancer diet is inappropriate for their particular pet, but we have an increasing number of studies in people to suggest that customizing the diet for an obese patient improves survival, and only one study in dogs suggesting that the high fat low carb diet makes a difference in survival. The veterinary oncologist that investigated the low carbohydrate diet for veterinary cancer patients has repeatedly written "*no one diet is right for every cancer patient*". Cancer patients experience changes in appetite associated with their treatments, and weight loss due to anorexia must be controlled by experimenting with palatable ingredients. On the other hand, if the patient is obese and eating well, a carefully monitored weight loss program with a customized diet may, in my opinion, be just as important.

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